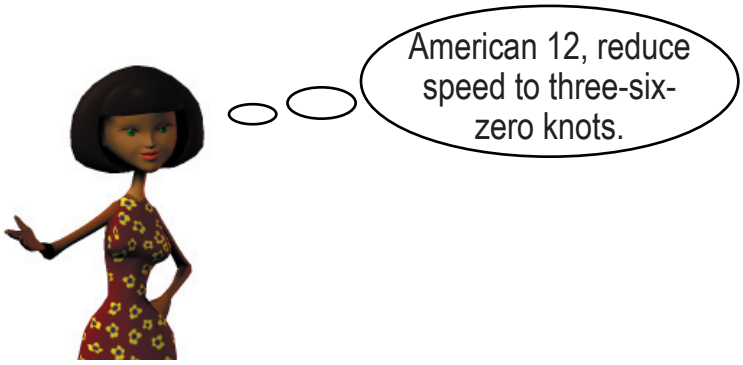
LineUp With Math™

Math-Based Decisions in Air Traffic Control

Student Workbook F

- **Resolving Air Traffic Conflicts by Changing Speed**
  - **3 planes, each at the same starting speed**
  - **Simulator problems 3-3, 3-4, 3-5, 3-6**

- **Simulator at:** **www.atcsim.nasa.gov**

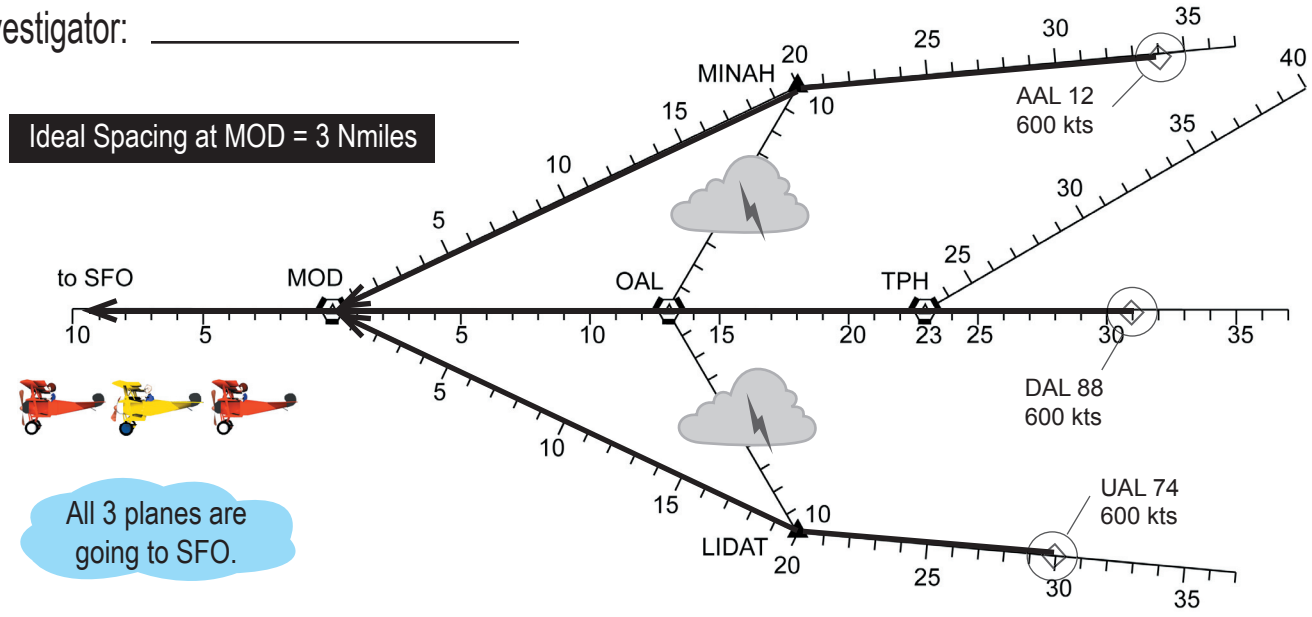


Investigator: _____

An Airspace Systems Program Product

Problem 3-3

Investigator: _____



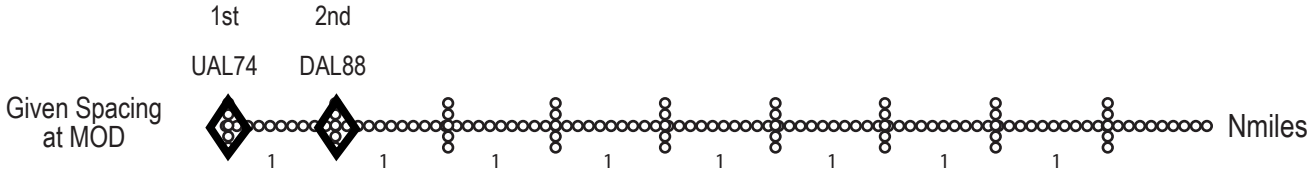
- If we need to change spacing, we must change speed. The alternate routes are closed.

1 To find the arrival order of the 3 planes at MOD, fill in the table.

Plane	AAL12	DAL88	UAL74
Distance to MOD, Nmi			
Arrival Order			

- To picture the arrival order and spacing of each plane, we use a number line.
- We start with the first plane to arrive and work back to the last plane.

2 Use a ◇ to show the order and spacing for the 3rd plane. Label your ◇ with "AAL12".



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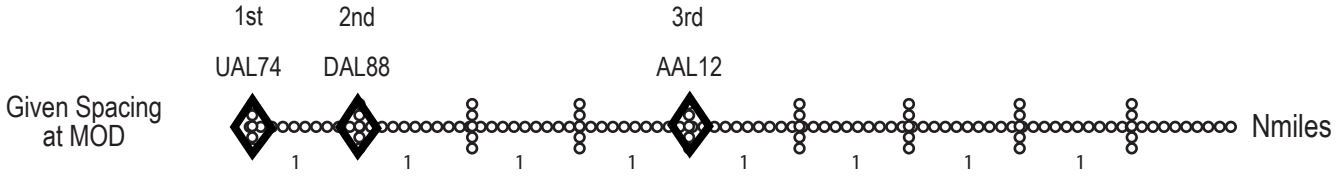
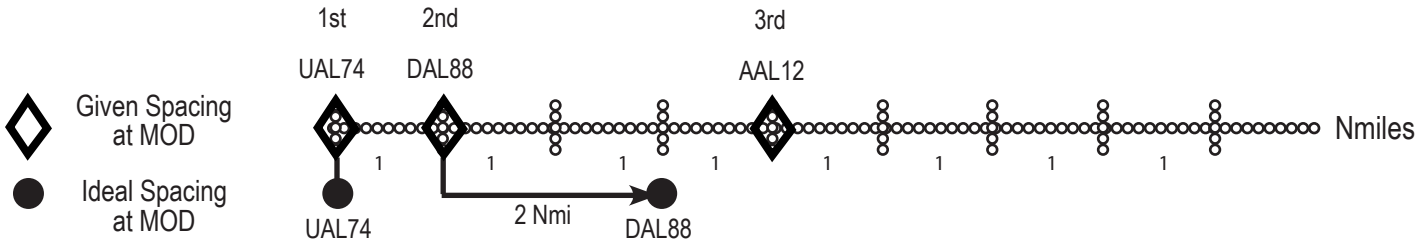


¤ Next we determine the additional spacing needed to get Ideal Spacing at MOD.

3 To get Ideal Spacing between the first and second plane, how much additional spacing do you need? ☐ Nmiles

¤ We use an arrow to show the additional spacing needed for the 2nd plane.
We picture the new spacing with a ● at the end of the arrow. We label the ● with the plane's call sign.



4 Now, how much additional spacing do you need between the second and third plane to get Ideal Spacing? (Be sure to use the NEW position of the second plane.) ☐ Nmiles

5 Use an arrow to show the additional spacing for the third plane (AAL12).
Put a ● at the end of the arrow to show the new spacing. Label the ● with "AAL12".

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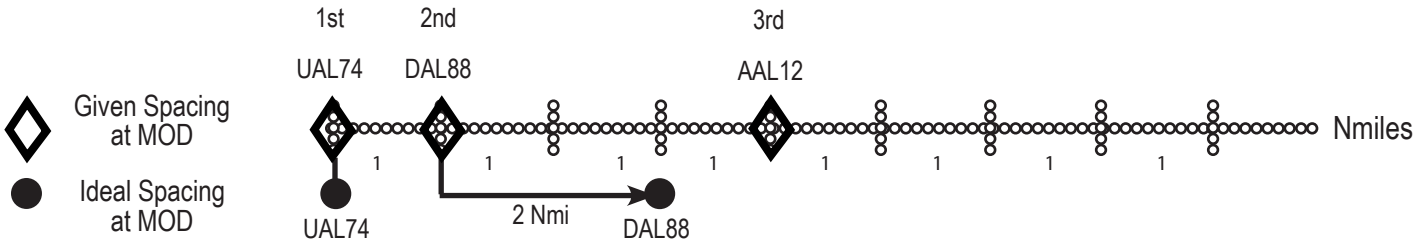
Investigator: _____

Problem 3-3 (Continued)



¤ Now that you know the additional spacing you need, what speed changes will you make? Begin with the second plane (DAL88)..

6 How much will you slow the DAL88 speed? ☐ Kts What will the new speed be? ☐ Kts

7 How many minutes will it take to get the additional spacing? ☐ Mins

A 60-knot difference in speed will cause a 1 Nmile difference in spacing **each minute.**

8 Will you get the additional spacing needed before MOD? ☐ Yes ☐ No

540 kts = 9 Nmi/Min

9 Now what speed changes will you make for the third plane, AAL12? Fill in the table.

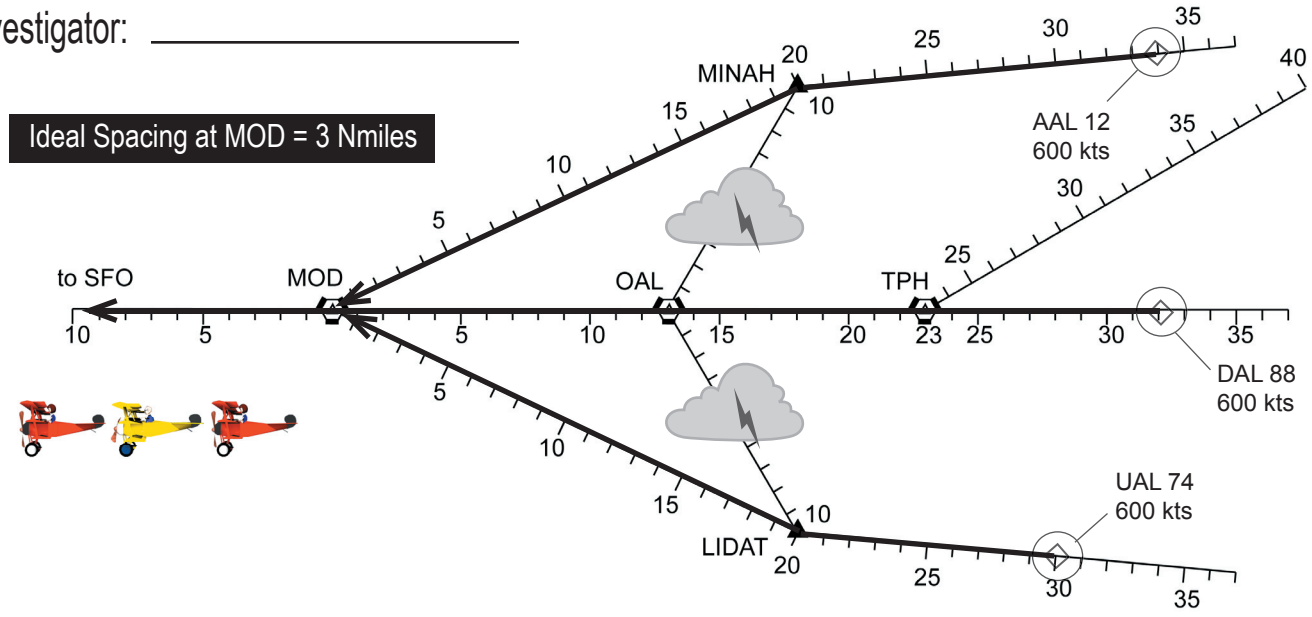
	Additional Spacing	New Speed	Time Until Ideal Spacing	At or Before MOD?
AAL12	☐ Nmi	☐ Kts	☐ Mins	☐ Yes ☐ No

If Yes, congratulations!

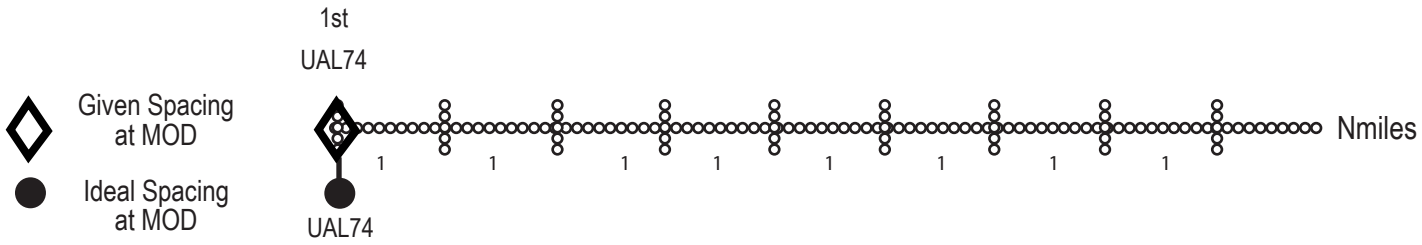
End of Worksheet

Problem 3-4

Investigator: _____



1 First, plot each plane's given spacing at MOD with an ◇. Then plot the Ideal Spacings with a ●. Label each symbol with the plane's call sign. Use an arrow to show the additional spacing needed.



2 What speed changes will you make to get Ideal Spacing at MOD? Fill in the table.

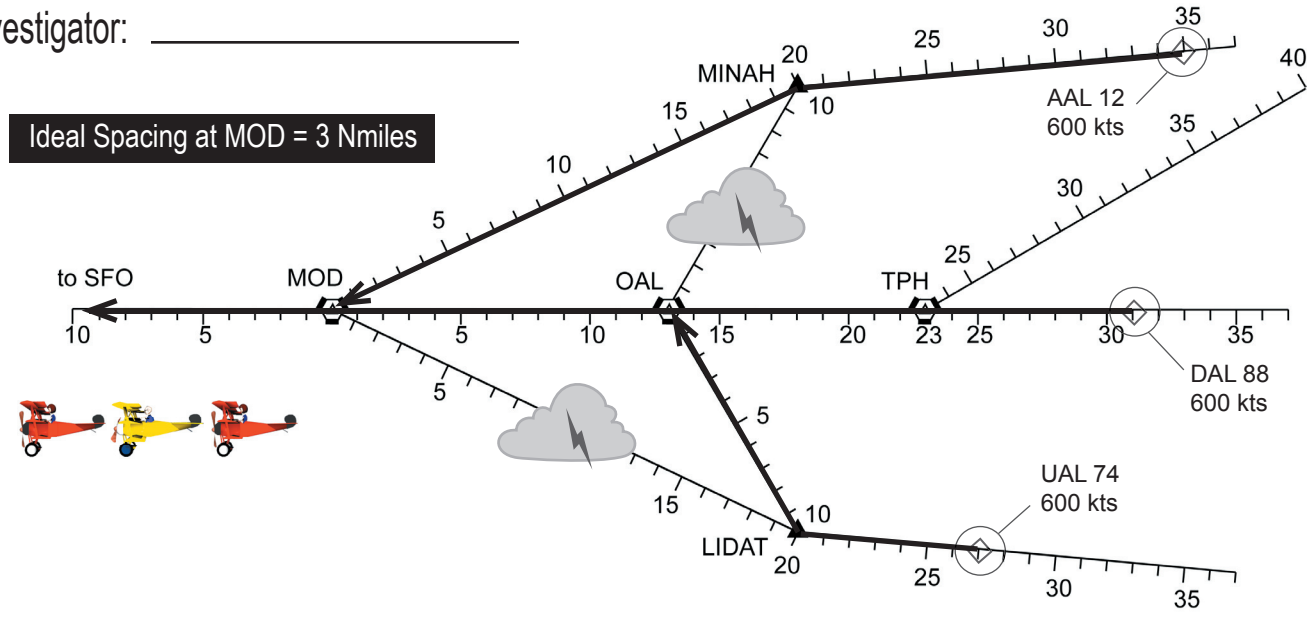
Order	Call Sign	**Additional** Spacing	New Speed	Time Until Ideal Spacing	At or Before MOD?
2nd		Nmi	Kts	Min	☐ Yes ☐ No
3rd		Nmi	Kts	Min	☐ Yes ☐ No

If Yes, congratulations!

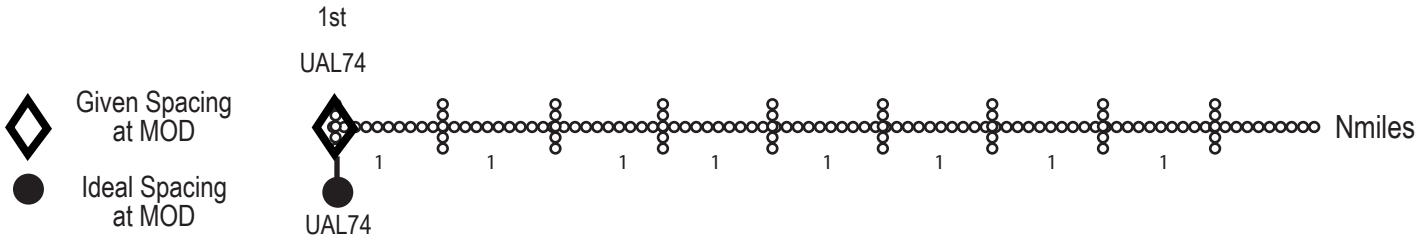
End of Worksheet

Problem 3-5

Investigator: _____



1 First, plot each plane's given spacing at MOD with an ◇. Then plot the Ideal Spacings with a . Label each symbol with the plane's call sign. Use an arrow to show the additional spacing needed.



2 What speed changes will you make to get Ideal Spacing at MOD? Fill in the table.

Order	Call Sign	**Additional** Spacing	New Speed	Time Until Ideal Spacing	At or Before MOD?
2nd		Nmi	Kts	Min	☐ Yes ☐ No
3rd		Nmi	Kts	Min	☐ Yes ☐ No

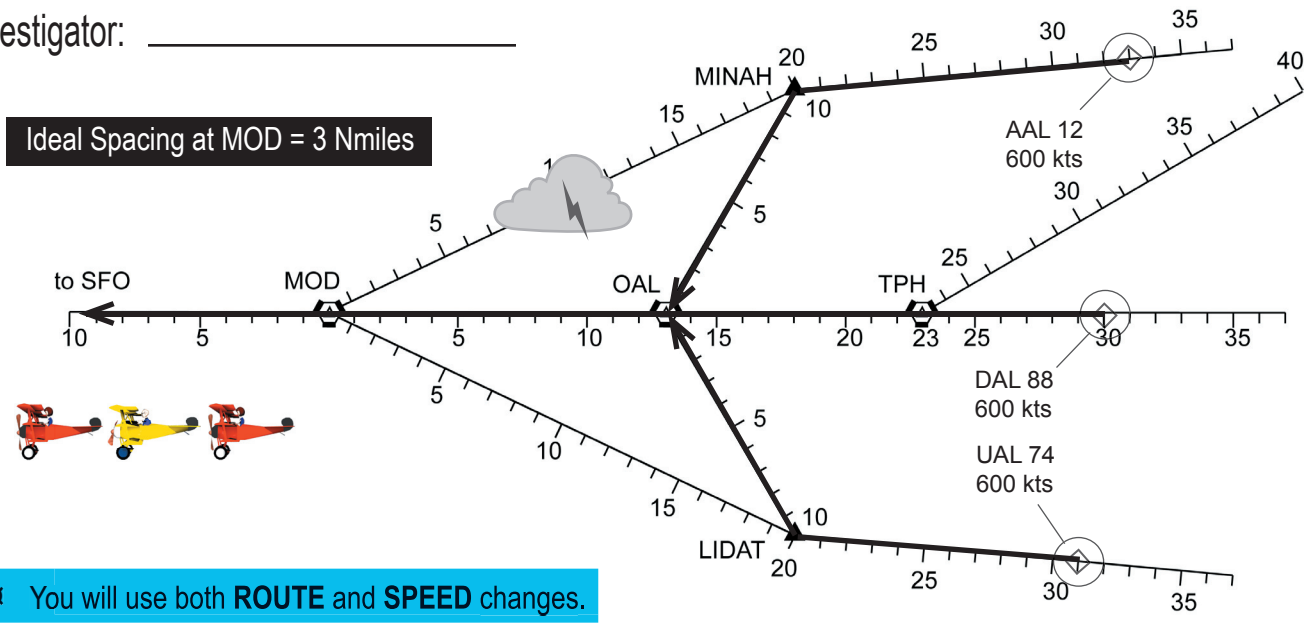
3 At the new speeds, will UAL74 and DAL88 have at least **minimum** spacing (2 Nmi) at **OAL**? ☐ No ☐ Yes

4 If No, how will you redo your speed changes?

End of Worksheet

Problem 3-6

Investigator: _____



¤ You will use both **ROUTE** and **SPEED** changes.

Remember, you need Ideal Spacing at MOD.

1 First, plot each plane's given spacing at MOD with an ◇. Then plot the Ideal Spacings with a ●. Label each symbol with the plane's call sign. Use an arrow to show the additional spacing needed.

◇ Given Spacing at MOD

● Ideal Spacing at MOD

1st DAL88

DAL88

Nmiles

2 For the second plane, what route change and speed change will give Ideal Spacing at MOD?

Changes: Route: _____ Speed: _____ Kts

3 For the route change, replot the *new* given and Ideal Spacings on the following line **AND** on the sector plot above.

◇ Given Spacing at MOD

● Ideal Spacing at MOD

1st DAL88

DAL88

Nmiles

4 For the speed change, after how many minutes will you speed up the plane to 600 kts to maintain ideal separation at MOD? _____ Minutes

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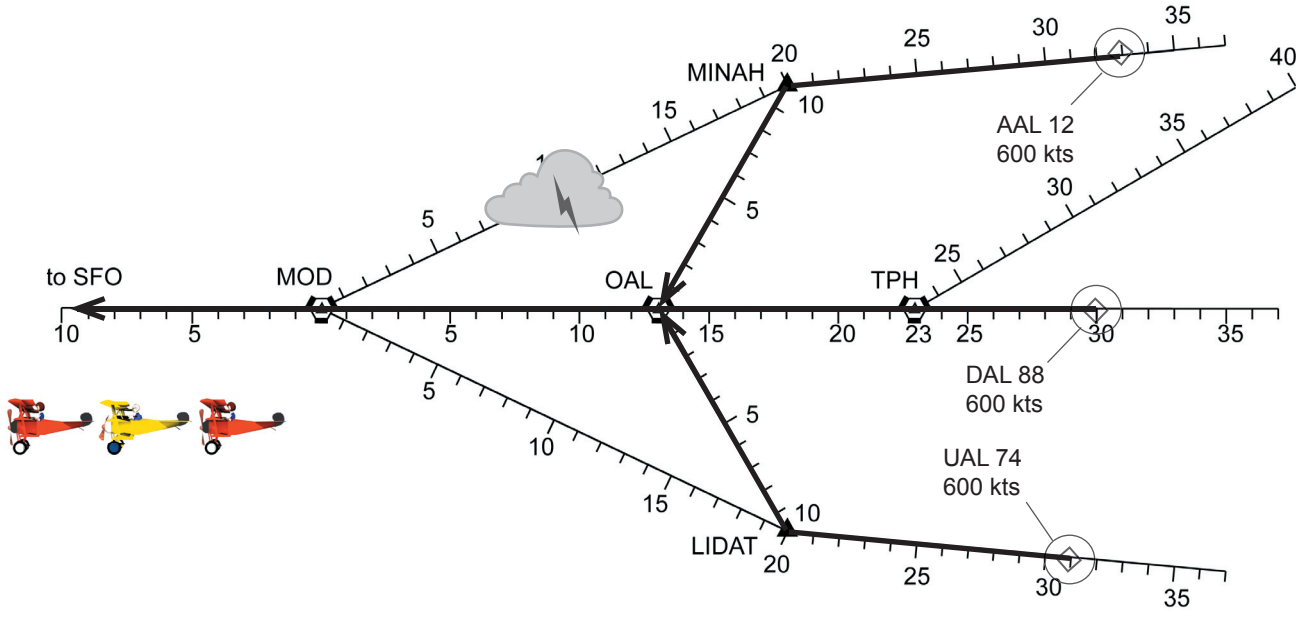
Investigator: _____

Problem 3-6 (Continued)



CAUTION **Be sure to mark the route and speed changes you have made on the above sector plot.**

5 For the third plane, describe your changes (if any) to get Ideal Spacing at MOD.

Changes: Route: _____ Speed: _____ Kts

6 If you changed speed, after how many minutes will you speed up the plane to 600 kts to maintain ideal separation at MOD? _____ Minutes

7 With your new speeds, will AA12 and DAL88 have at least the 2 Nmi **Minimum** Separation at **OAL**? ☐ No ☐ Yes

8 If No, how will you redo your route or speed changes?

_____

_____

End of Worksheet